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Hsieh et al.

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(54) **OPTICAL LENS SYSTEM WITH A WIDE FIELD OF VIEW**

(75) Inventors: **Dung-Yi Hsieh**, Taichung (TW); **Hsin-Hsuan Huang**, Taichung (TW)

(73) Assignee: **Largan Precision Co., Ltd.**, Taichung (TW)

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G02B 9/64 (2006.01)
G02B 13/04 (2006.01)

(52) **U.S. Cl.** **359/755**; 359/751

(58) **Field of Classification Search** 359/751, 359/755

See application file for complete search history.

(56) **References Cited**

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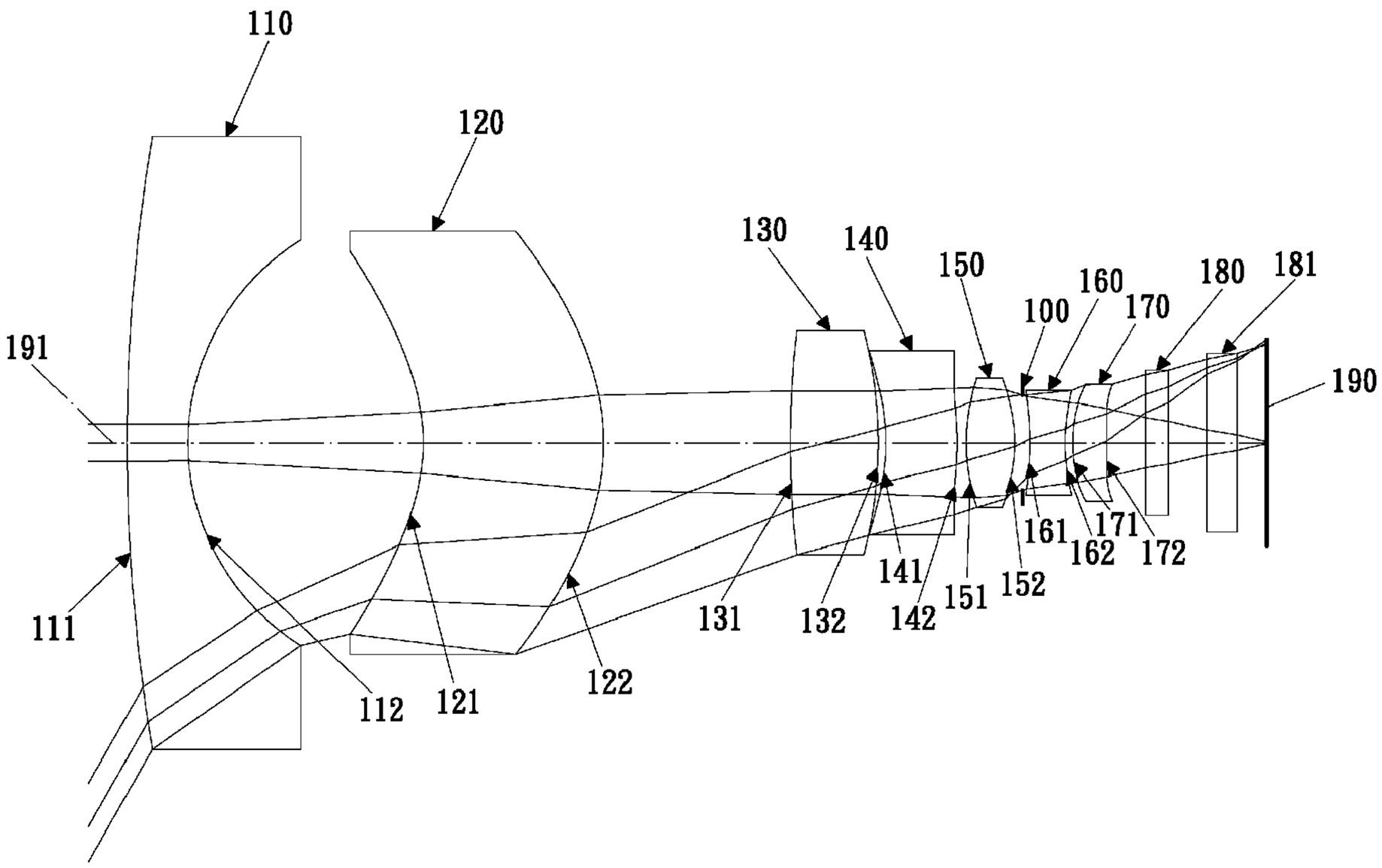
Primary Examiner — William Choi

(57) **ABSTRACT**

An optical lens system with a wide field of view comprises, in order from the object side to the image side: a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a second lens element; a third lens element; a fourth lens element having a concave object-side surface and a convex image-side surface; a fifth lens element with positive refractive power; a sixth lens element with negative refractive power; a seventh lens element, one of an object-side surface and an image-side surface being aspheric. There are seven lens elements with refractive power. By adjusting the arrangement of curvature, refractive power of the respective lens elements and a stop, sufficient field of view can be obtained and the aberrations of the system can be corrected in order to obtain good image quality.

25 Claims, 10 Drawing Sheets



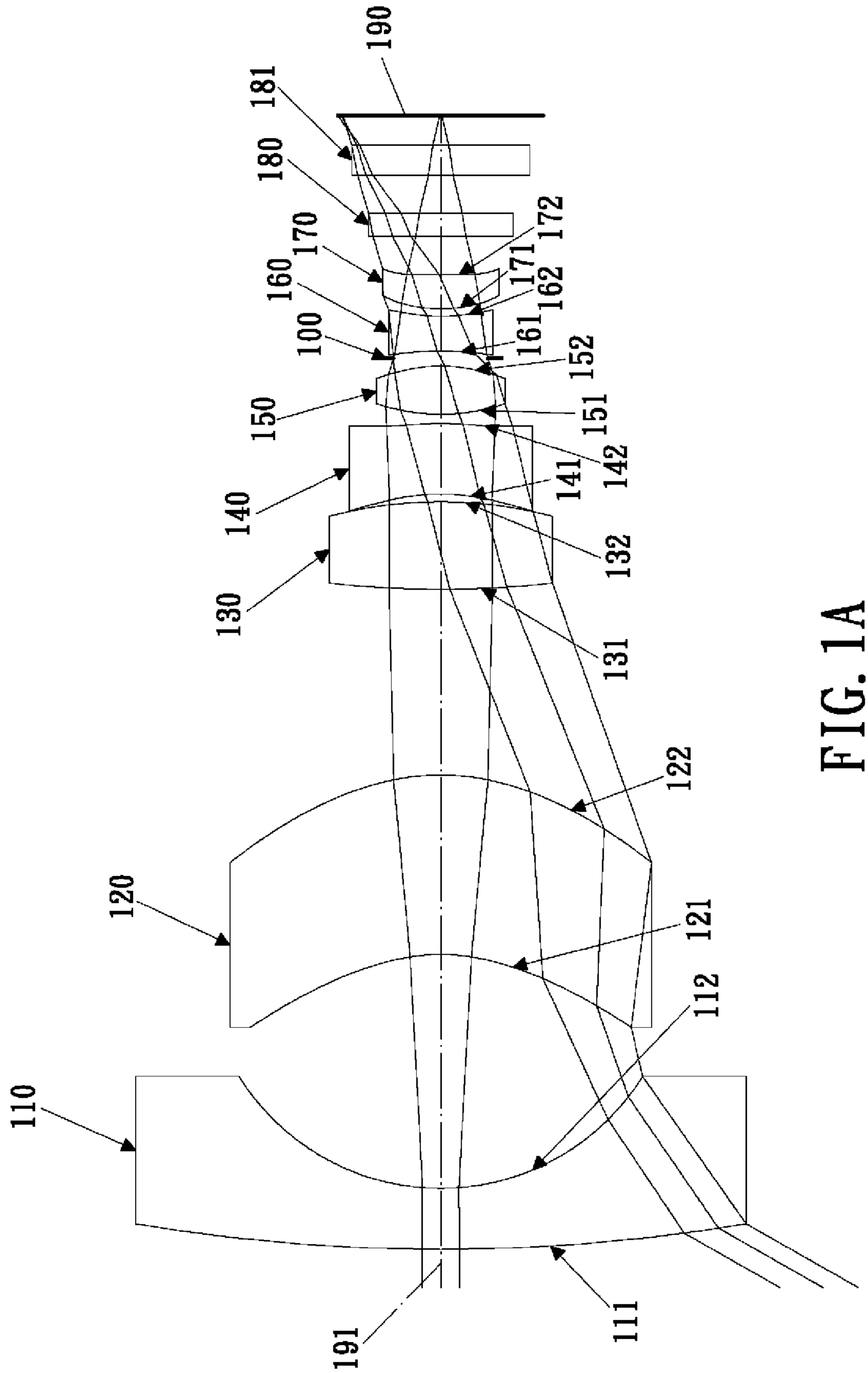

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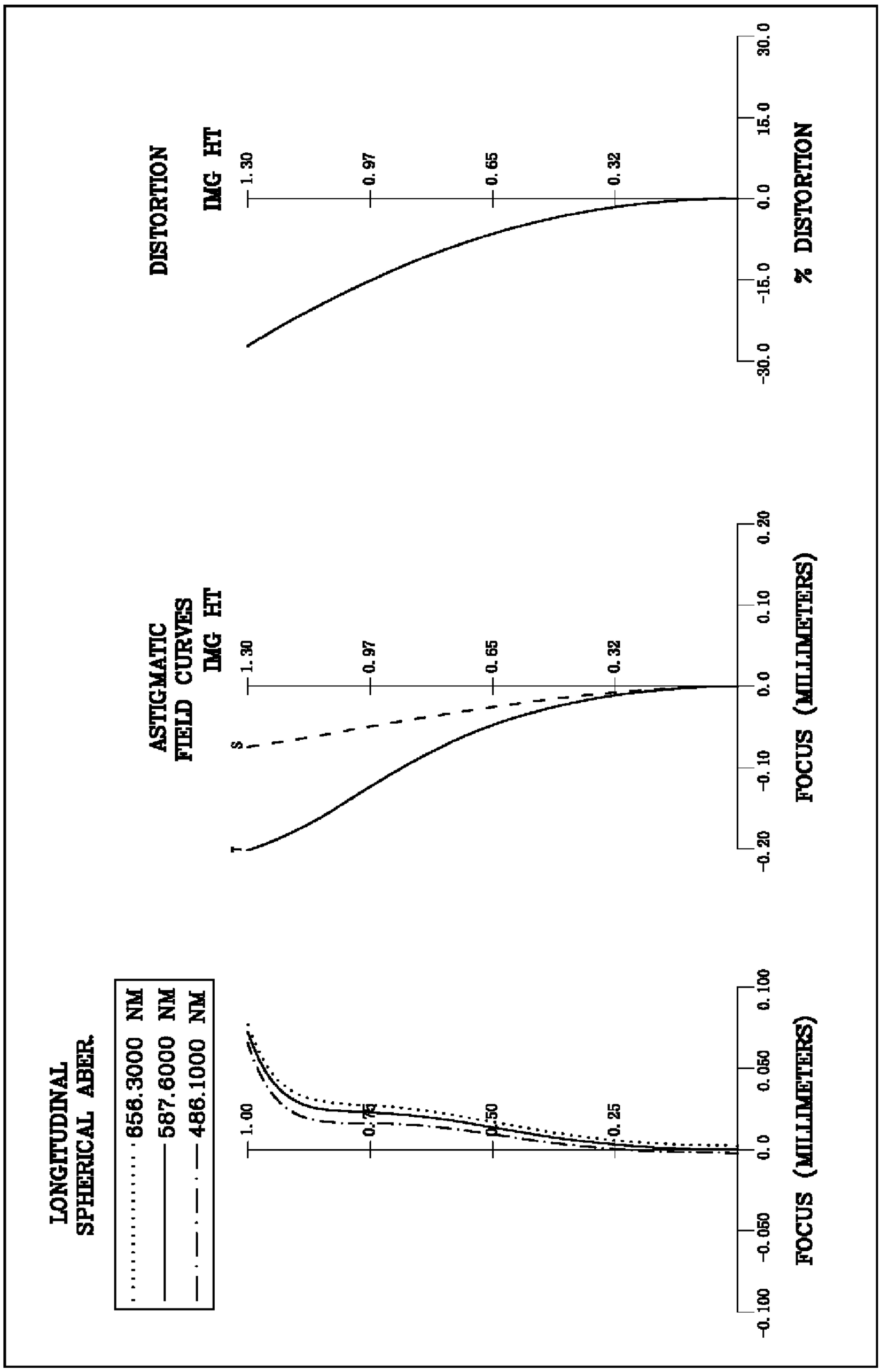
FIG. 1A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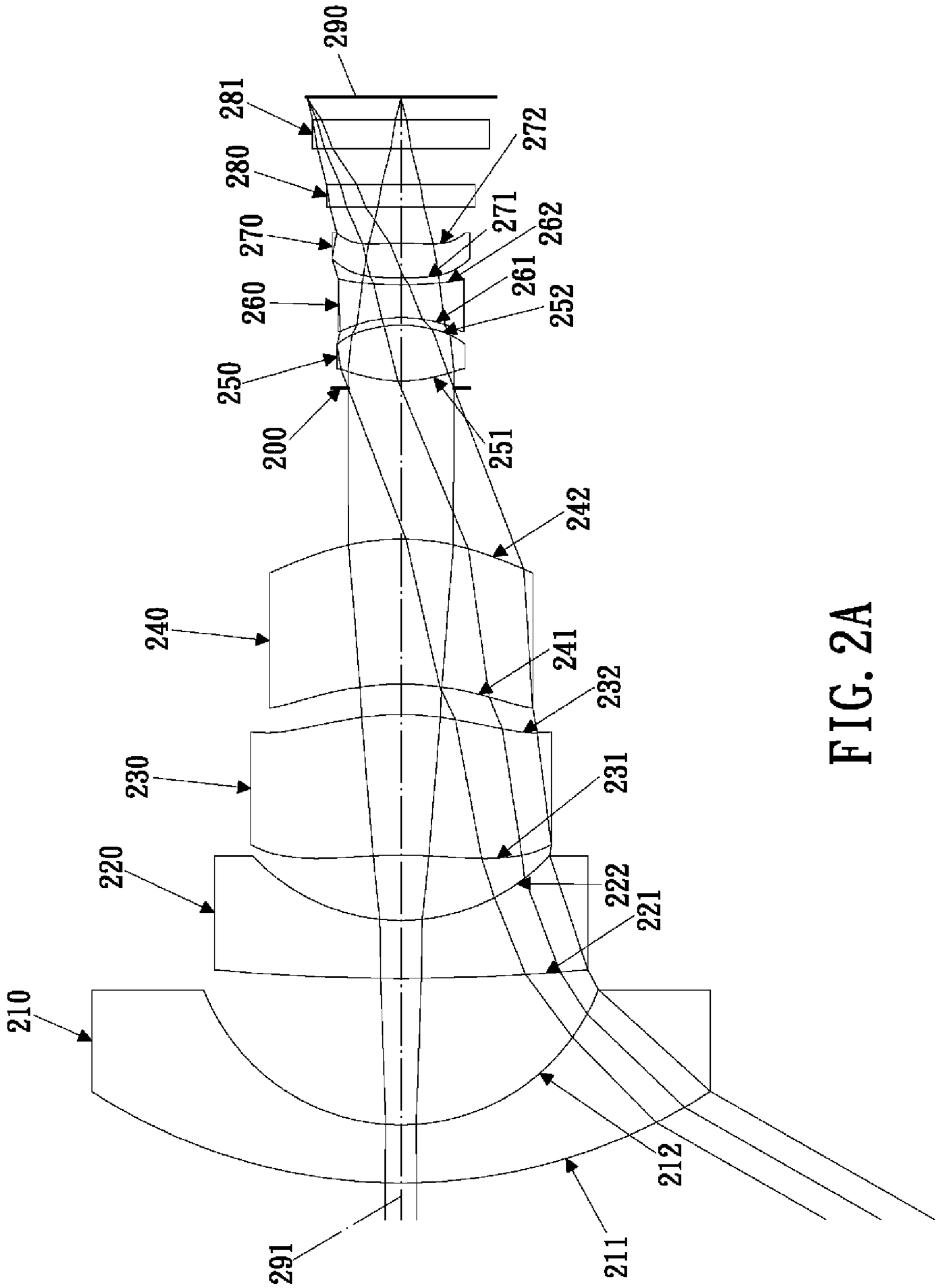
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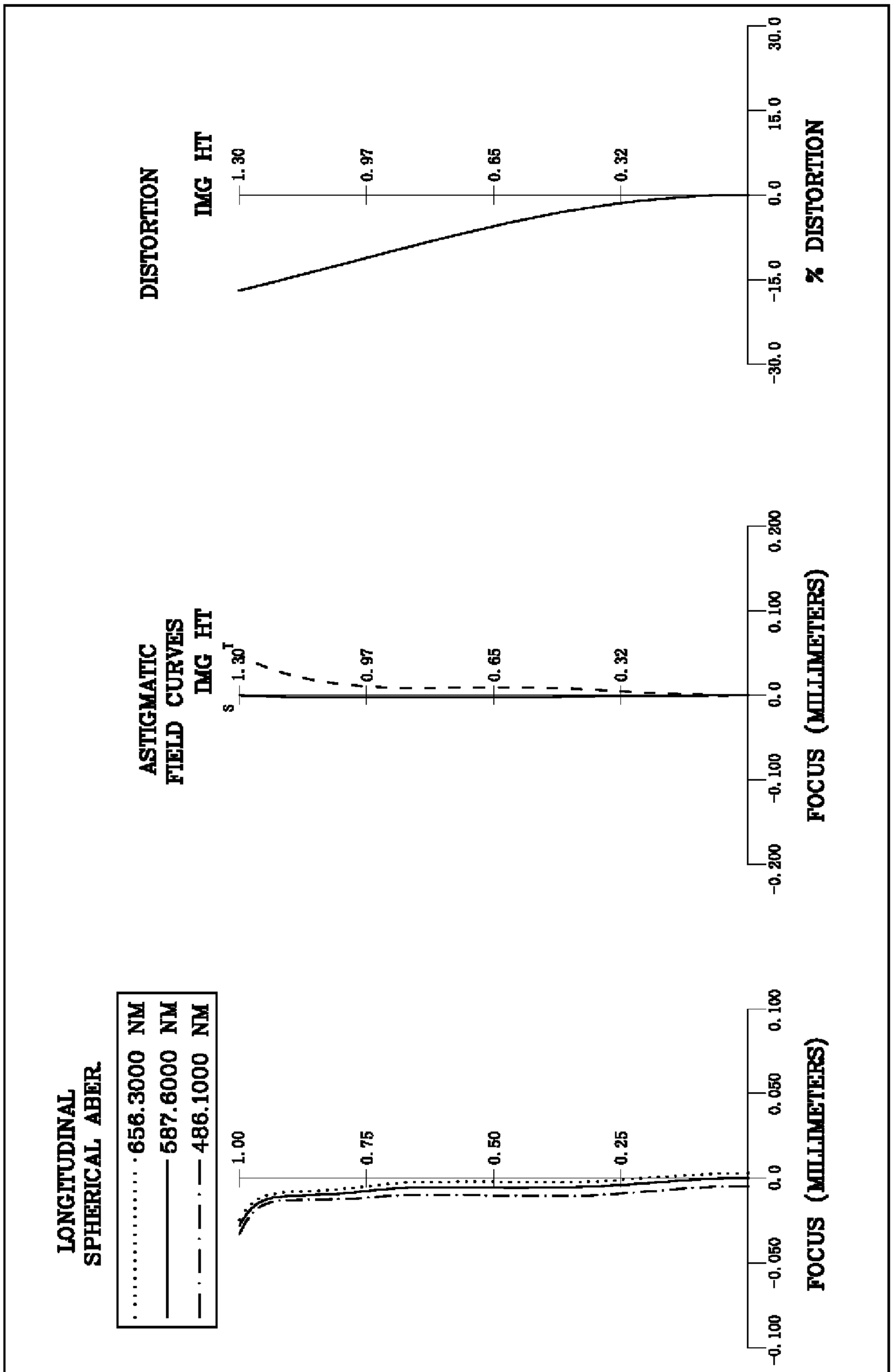
FIG. 2A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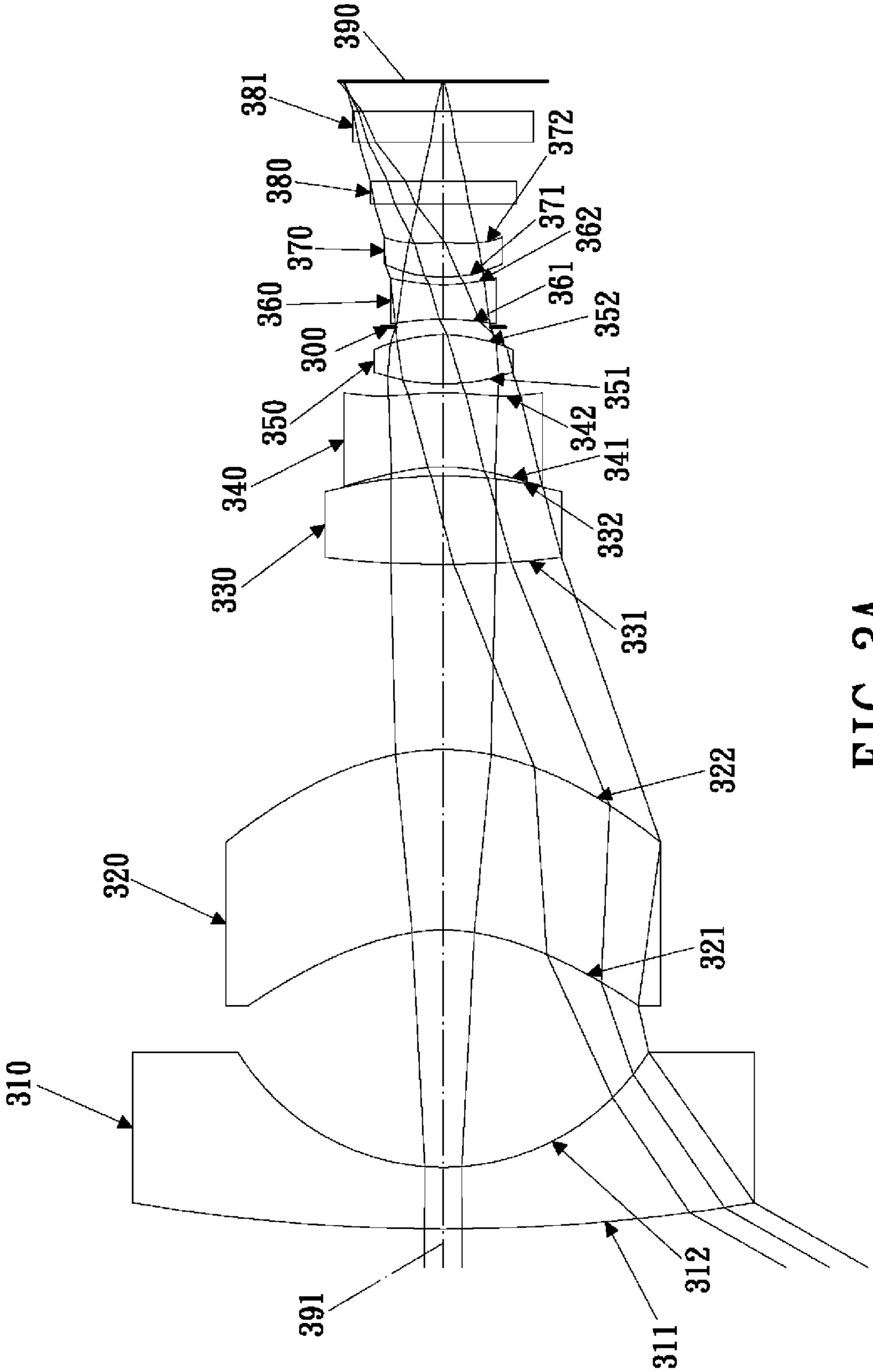
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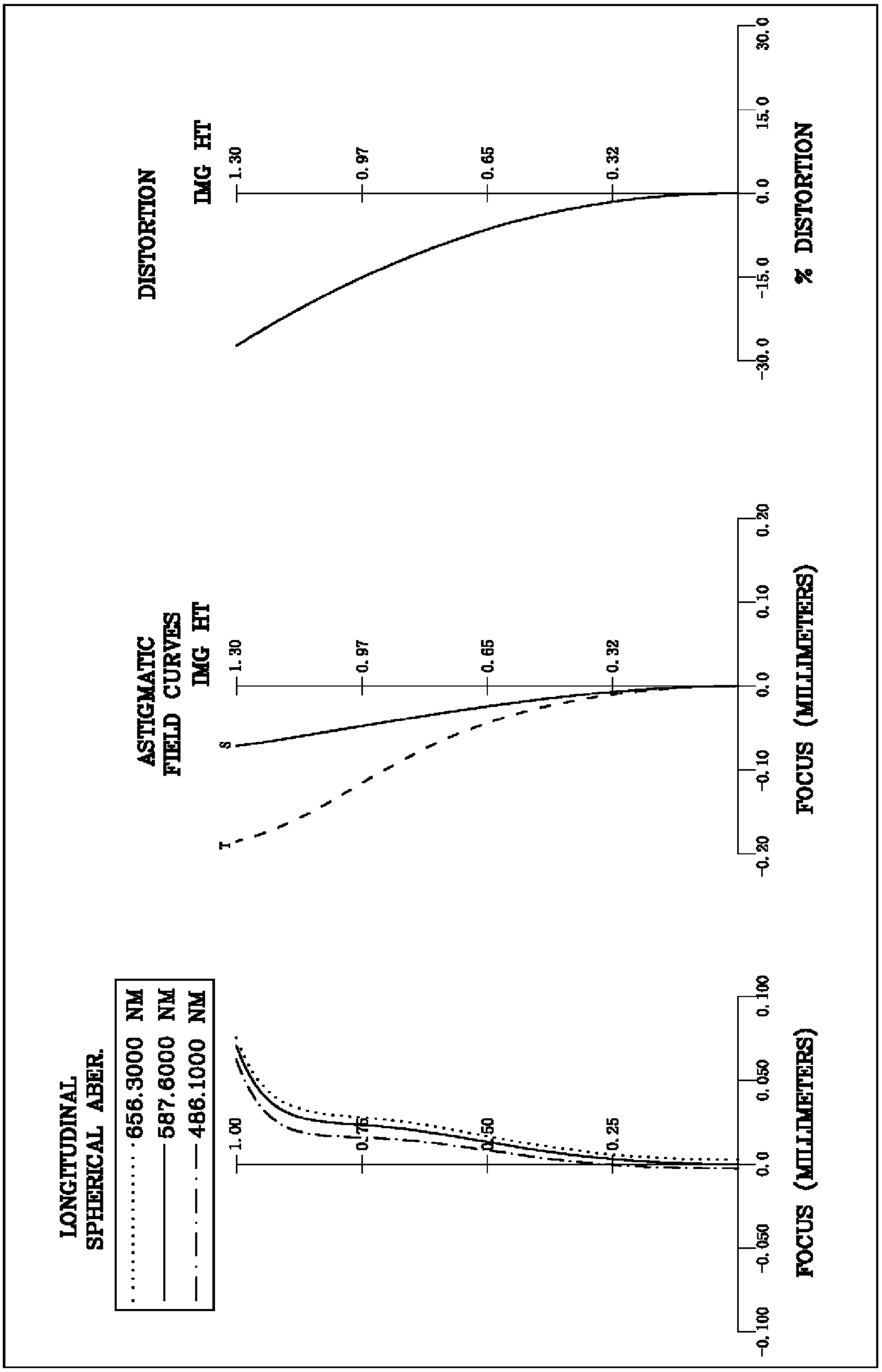
FIG. 3A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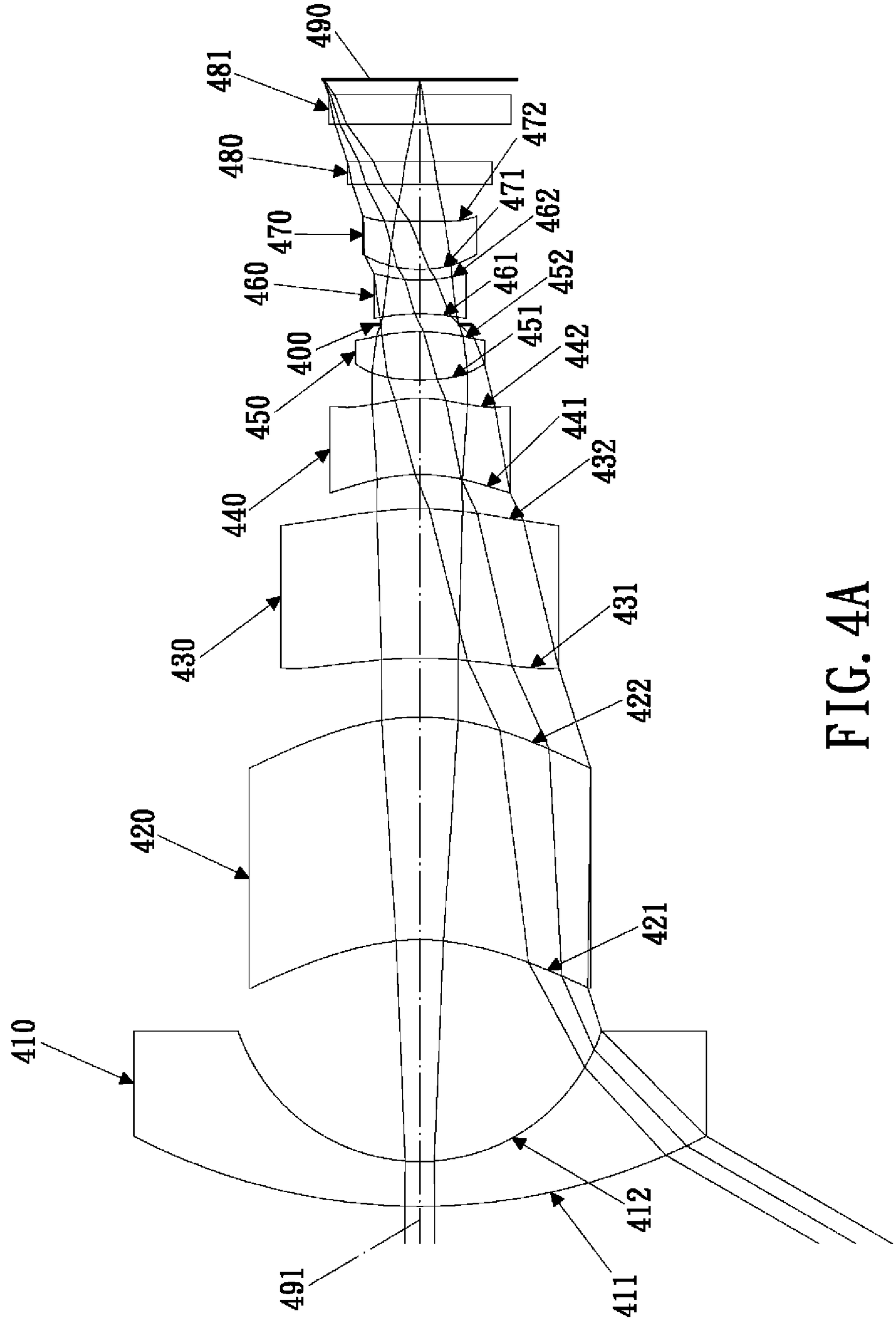
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FIG. 4A

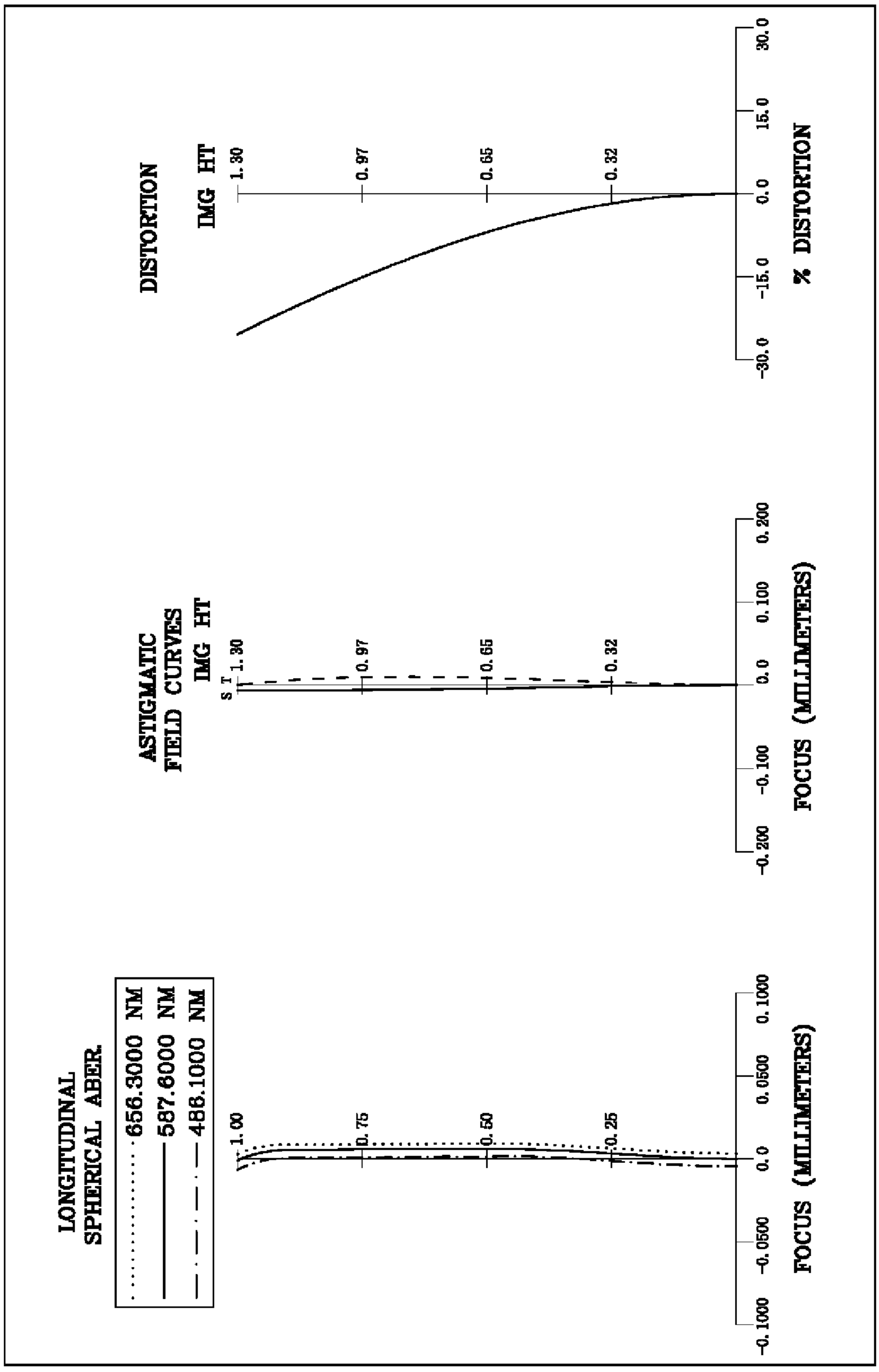
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FIG. 4B

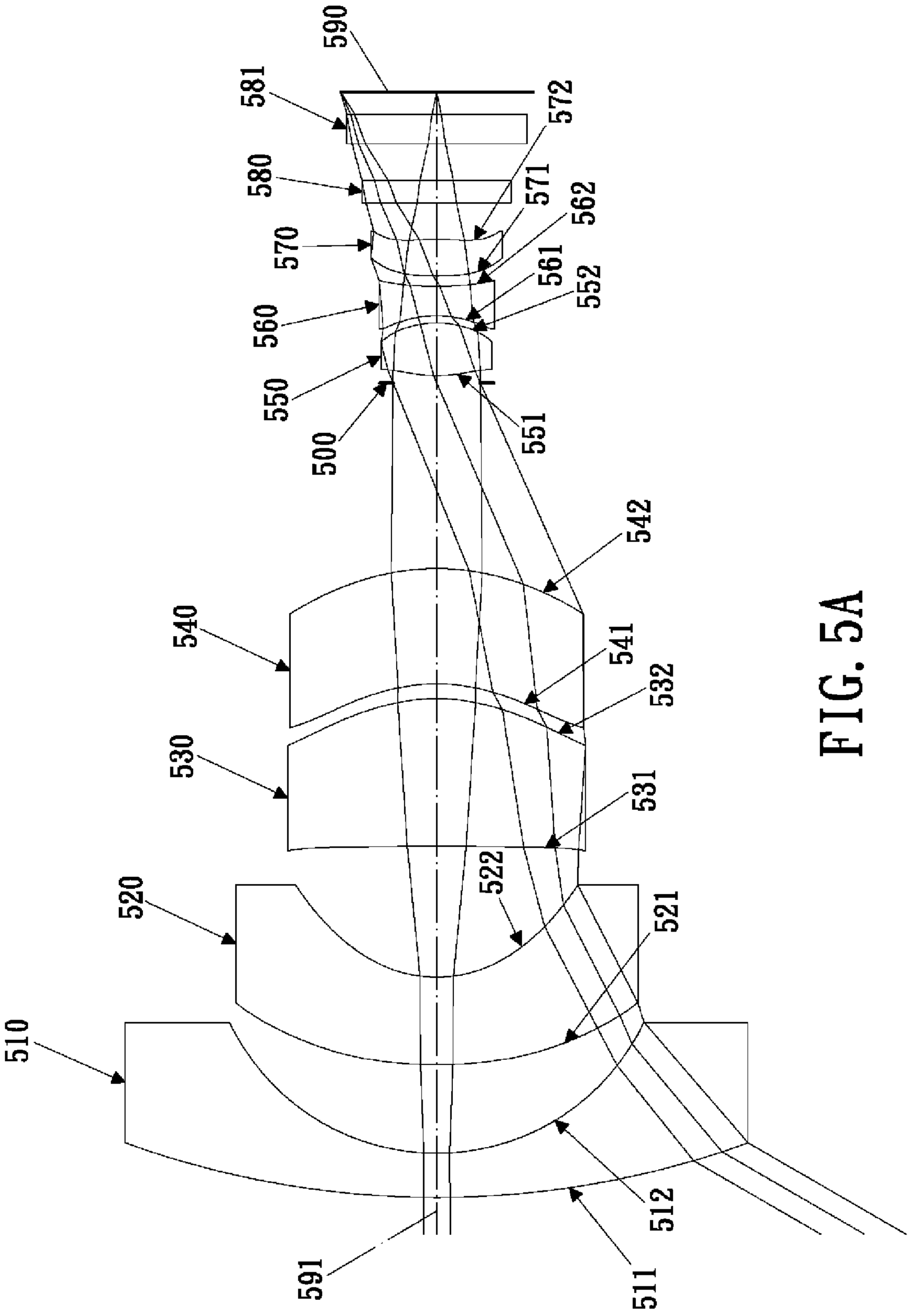
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FIG. 5A

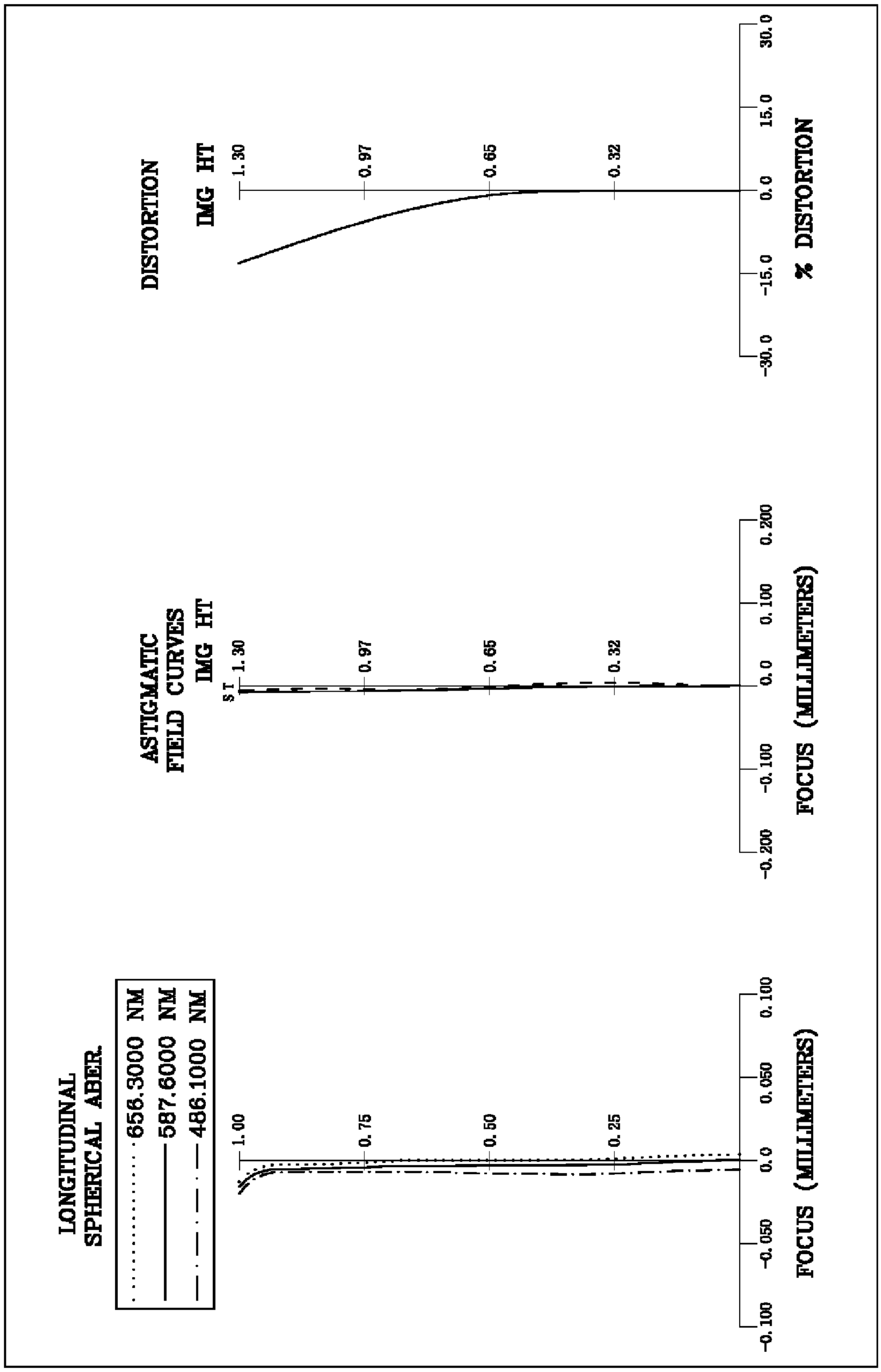
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FIG. 5B

OPTICAL LENS SYSTEM WITH A WIDE FIELD OF VIEW

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an optical lens system with a wide field of view, and more particularly to a miniaturized optical lens system with a larger field of view.

2. Description of the Prior Art

In recent years, the optical lens system has been widely applied in different industries, especially in the industries of the mobile phone cameras, network cameras, automotive lenses, image monitoring, entertainment electronics and so on, and the electronic sensor of a general digital camera is typically a CCD (Charge Coupled Device) or CMOS (Complementary Metal Oxide Semiconductor) sensor. Due to advances in semiconductor manufacturing, the pixel size of sensor has been reduced continuously, and miniaturized optical lens systems have increasingly higher resolution. Therefore, there's an increasing demand for an imaging lens system with better image quality.

Lens systems used in vehicles, image monitoring and electronic entertainment devices usually need a larger field of view since they need to capture a wider range of images at a time. The conventional lens systems with a larger field of view mostly consist of a front lens group with negative refractive power and a rear lens group with positive refractive power, forming a so-called Inverse Telephoto structure, which can provide a wide field of view, such as the optical lens system described in U.S. Pat. No. 7,446,955. Although the Inverse Telephoto structure can obtain a wide field of view, it is difficult to correct aberrations of the system due to the fact that the rear lens group only consists of one lens element. Moreover, in recent years, with the popularity of the vehicle rear view system, the wide field of view optical lens system with a high resolution has become a trend in the market. Therefore, the present invention is aimed at providing a wide field of view optical lens system which can provide great image quality without make the total track length of the optical lens system too long.

The present invention mitigates and/or obviates the aforementioned disadvantages.

SUMMARY OF THE INVENTION

The primary objective of the present invention is to provide an optical lens system with a wide field of view to correct aberrations of the system and obtain good image quality.

An optical lens system with a wide field of view in accordance with the present invention comprises, in order from the object side to the image side: a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a second lens element; a third lens element; a fourth lens element having a concave object-side surface and a convex image-side surface; a fifth lens element with positive refractive power; a sixth lens element with negative refractive power; a seventh lens element, at least one of an object-side and an image-side surfaces of the first lens element being aspheric. In the optical lens system with a wide field of view, there are seven lens elements with refractive power. The radius of curvature of the object-side surface of the sixth lens element is R11, the radius of curvature of the image-side surface of the sixth lens element is R12, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element is f1, the focal length of the second lens element is f2, the focal length of the third lens element is f3, the focal length of the fourth lens element is f4, the focal length of the fifth lens element is f5, the focal length of the sixth lens element is f6, and the focal length of the seventh lens element is P. The optical lens system is further provided with a stop, the distance from the stop to an image plane along the optical axis is SL, the distance from the object-side surface of the first lens element to the image plane along the optical axis is TTL, and they satisfy the relations: $-0.7<(R11+R12)/(R11-R12)<0.7$; $SUM|pow|<2.5$, wherein $SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|$; $0.15<SL/TTL<0.40$. Such arrangements can obtain sufficient field of view, correct aberrations of the system and obtain good image quality.

The first lens element with negative refractive power has a convex object-side surface and a concave image-side surface, which is favorable to enlarge the field of view of the optical lens system, improve the refraction of incident light, prevent the excessive increase of aberrations, and obtain good balance between the field of view and the aberrations of the system.

The fourth lens element has a concave object-side surface and a convex image-side surface, which is favorable to correct the astigmatism of the system.

The fifth lens element with positive refractive power can provide partial refractive power for the optical lens system, and reduce the total track length of the optical lens system.

The sixth lens element with negative refractive power can effectively correct aberrations of the optical lens system.

If $(R11+R12)/(R11-R12)$ satisfies the relation: $-0.7<(R11+R12)/(R11-R12)<0.7$, the curvatures of the object-side and image-side surfaces of the sixth lens element are appropriate for the arrangement of the fifth and seventh lens elements, so that the total track length of the optical lens system will not be too long.

If $SUM|pow|$ satisfies the relation: $SUM|pow|<2.5$, the refractive power of the respective lens elements and the optical lens system will be appropriate, which can prevent the excessive generations of aberrations when the refractive power of any of the lens elements is excessively large. Preferably, $SUM|pow|$ satisfies the relation: $SUM|pow|<2.0$.

If SL/TTL satisfies the relation: $0.15<SL/TTL<0.40$, the stop can be located at a favorable position for wide field of view and for better correction of the distortion and the chromatic aberration of magnification.

According to one aspect of the present optical lens system with a wide field of view, the second lens element with negative refractive power can function favorably with the first lens element to enlarge the field of view and correct aberrations of the optical lens system. The third lens element with positive refractive power can reduce the sensitivity of the optical lens system. The seventh lens element with positive refractive power can further reduce the total track length of the optical lens system, so as to maintain the objective of miniaturization of the optical lens system.

According to another aspect of the present optical lens system, if the second lens element has a convex object-side surface and a concave image-side surface, it can function favorably with the first lens element with negative refractive power having a convex object-side surface and a concave image-side surface to enlarge the field of view. If the second lens element has a concave object-side surface and a convex image-side surface, it will be favorable to correct aberrations of the optical lens system. If the third lens element has a concave object-side surface and a convex image-side surface, it will be favorable to correct astigmatism of the system. If the fifth lens element has a convex object-side surface and a concave image-side surface, it will be favorable to enhance the positive refractive power of the fifth lens element and

reduce the total track length of the optical lens system. If the sixth lens element has a concave object-side surface and a concave image-side surface, it can effectively correct aberrations of the optical lens system. If the seventh lens element has a convex object-side surface, it will be favorable to correct the high order aberrations of the system.

According to another aspect of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element is f1, the focal length of the second lens element is f2, the focal length of the third lens element is f3, the focal length of the fourth lens element is f4, the focal length of the fifth lens element is f5, the focal length of the sixth lens element is f6, and the focal length of the seventh lens element is f7, and they satisfy the relations: P5=|f/f5|, P6=|f/f6|, P7=|f/f7|, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|. If (P5+P6+P7)/(SUM|pow|) satisfies the relation: 0.5<(P5+P6+P7)/(SUM|pow|)<1.0, the distribution of the refractive power of the last three lens elements (the fifth, sixth and seventh lens elements) will be appropriate, which can effectively correct various aberrations of the optical lens system. Preferably, (P5+P6+P7)/(SUM|pow|) satisfies the relation:

$$0.65<(P5+P6+P7)/(\mathrm{SUM}|\mathrm{pow}|)<0.80.$$

According to another aspect of the present optical lens system, the first lens element is made of glass, and the refractive index of the first lens element is N1. If N1 satisfies the relation: N1>1.70, the material of the first lens element will be appropriate, which can prevent the generation of excessive aberrations in case of a wide field of view.

According to another aspect of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and a distance on an optical axis between the fourth lens element and the fifth lens element is T45. If T45/f satisfies the relation: 2.0<T45/f<3.5, there will be enough space between the fourth lens element and the fifth lens element to allow the fourth lens element to be adjusted to an optimal position within the system.

According to another aspect of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and the focal length of the fourth lens element is f4. If |f/f4| satisfies the relation: |f/f4|<0.2, the refractive power of the fourth lens elements can effectively correct aberrations of the optical lens system. Preferably, |f/f4| satisfies the relation: |f/f4|<0.1, the refractive power of the fourth lens elements will be appropriate, which can effectively correct aberrations of the optical lens system.

According to another aspect of the present optical lens system, the distance between the object-side surface of the fifth lens element and the image-side surface of the seventh lens element is Dr9r14, and the distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td. If Dr9r14/Td satisfies the relation: 0.07<Dr9r14/Td<0.25, the rear lens group (from the fifth lens element to the seventh lens element) has a better configuration, which can effectively reduce the total track length of the optical lens system. Preferably, Dr9r14/Td satisfies the relation: 0.12<Dr9r14/Td<0.18.

According to another aspect of the present optical lens system, the Abbe number of the sixth lens element is V6, and the Abbe number of the seventh lens element is V7. If V7−V6 satisfies the relation: 28.0<V7−V6<40.0, it can allow better correction of the chromatic aberration of the optical lens system.

According to another aspect of the present optical lens system, the distance between the object-side surface of the first lens element and the object-side surface of the third lens element is Dr1r5, and the distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td. If Dr1r5/Td satisfies the relation: 0.5<Dr1r5/Td<0.8, the first lens element and the second lens element can effectively moderate aberrations of the optical lens system.

According to another aspect of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and the focal length of the first lens element is f4. If f/f1 satisfies the relation: −0.3<f/f1<−0.1, the refractive power of the first lens element will be appropriate, which can effectively enhance the feature of wide field of view and provide a larger field of view.

According to another aspect of the present optical lens system, the radius of curvature of the object-side surface of the fourth lens element is R7, and the radius of curvature of the image-side surface of the fourth lens element is R8. If |(R7+R8)/(R7−R8)| satisfies the relation: 4.5<|(R7+R8)/(R7−R8)|<9.0, the curvature of the object-side and image-side surfaces of the fourth lens element can effectively correct the astigmatism of the system.

According to another aspect of the present optical lens system, the radius of curvature of the object-side surface of the second lens element is R3, and the radius of curvature of the image-side surface of the second lens element is R4. If R3/R4 satisfies the relation: 0.75<R3/R4<1.2, it can enhance the aberrations correction effect of the second lens element.

According to another aspect of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and the focal length of the second lens element is f2. If |f/f2| satisfies the relation: |f/f2|<0.2, the second lens element can function with the first lens element to avoid producing too many aberrations while providing a wide field of view.

The present invention will be presented in further details from the following descriptions with the accompanying drawings, which show, for purpose of illustrations only, the preferred embodiments in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A shows an optical lens system in accordance with a first embodiment of the present invention;

FIG. **1**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the first embodiment of the present invention;

FIG. **2**A shows an optical lens system in accordance with a second embodiment of the present invention;

FIG. **2**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the second embodiment of the present invention;

FIG. **3**A shows an optical lens system in accordance with a third embodiment of the present invention;

FIG. **3**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the third embodiment of the present invention;

FIG. **4**A shows an optical lens system in accordance with a fourth embodiment of the present invention;

FIG. **4**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the fourth embodiment of the present invention;

FIG. **5**A shows an optical lens system in accordance with a fifth embodiment of the present invention; and

FIG. **5**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the fifth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1**A, which shows an optical lens system with a wide field of view in accordance with a first embodiment of the present invention, and FIG. **1**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the first embodiment of the present invention. An optical lens system with a wide field of view in accordance with the first embodiment of the present invention comprises, in order from the object side to the image side:

A first lens element **110** with negative refractive power made of glass has a convex object-side surface **111** and a concave image-side surface **112**.

A second lens element **120** with positive refractive power made of plastic has a concave object-side surface **121** and a convex image-side surface **122**, and the object-side surface **121** and the image-side surface **122** of the second lens element **120** are aspheric.

A third lens element **130** with positive refractive power made of glass has a convex object-side surface **131** and a convex image-side surface **132**.

A fourth lens element **140** with negative refractive power made of plastic has a concave object-side surface **141** and a convex image-side surface **142**, and the object-side surface **141** and the image-side surface **142** of the fourth lens element **140** are aspheric.

A fifth lens element **150** with positive refractive power made of plastic has a convex object-side surface **151** and a convex image-side surface **152**, and the object-side surface **151** and the image-side surface **152** of the fifth lens element **150** are aspheric.

A sixth lens element **160** with negative refractive power made of plastic has a concave object-side surface **161** and a concave image-side surface **162**, and the object-side surface **161** and the image-side surface **162** of the sixth lens element **160** are aspheric.

A seventh lens element **170** with positive refractive power made of plastic has a convex object-side surface **171** and a convex image-side surface **172**, and the object-side surface **171** and the image-side surface **172** of the seventh lens element **170** are aspheric.

A stop **100** is located between the fifth lens element **150** and the sixth lens element **160**.

An IR cut filter **180** made of glass is located between the image-side surface **172** of the seventh lens element **170** and an image plane **190** and has no influence on the focal length of the optical lens system.

A cover glass **181** made of glass is located between the IR cut filter **180** and the image plane **190** to protect a sensor (not shown), and has no influence on the focal length of the optical lens system.

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and it satisfies the relation:

$$f=1.04.$$

In the first embodiment of the present optical lens system, the f-number of the optical lens system with a wide field of view is Fno, and it satisfies the relation:

$$Fno=2.08.$$

In the first embodiment of the present optical lens system, half of the maximal field of view is HFOV, and it satisfies the relation:

$$HFOV=60.4.$$

In the first embodiment of the present optical lens system, the Abbe number of the seventh lens element **170** is V7, the Abbe number of the sixth lens element **160** is V6, and they satisfy the relation:

$$|V7-V6|=32.90.$$

In the first embodiment of the present optical lens system, the radius of curvature of the object-side surface **121** of the second lens element **120** is R3, the radius of curvature of the image-side surface **122** of the second lens element **120** is R4, and they satisfy the relation:

$$R3/R4=0.85.$$

In the first embodiment of the present optical lens system, the radius of curvature of the object-side surface **141** of the fourth lens element **140** is R7, the radius of curvature of the image-side surface **142** of the fourth lens element **140** is R8, and they satisfy the relation:

$$|(R7+R8)/(R7-R8)|=5.42.$$

In the first embodiment of the present optical lens system, the radius of curvature of the object-side surface **161** of the sixth lens element **160** is R11, the radius of curvature of the image-side surface **162** of the sixth lens element **160** is R12, and they satisfy the relation:

$$(R11+R12)/(R11-R12)=0.34.$$

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the distance on the optical axis between the fourth lens element **140** and the fifth lens element **150** is T45, and they satisfy the relation:

$$T45/f=0.12.$$

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **110** is f1, and they satisfy the relation:

$$f/f1=-0.23.$$

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the second lens element **120** is f2, and they satisfy the relation:

$$|f/f2|=0.04.$$

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element **140** is f4, and they satisfy the relation:

$$|f/f4|=0.04.$$

In the first embodiment of the present optical lens system, the distance between the object-side surface **111** of the first lens element **110** and the object-side surface **131** of the third lens element **130** is Dr1r5, the distance between the object-side surface **111** of the first lens element **110** and the image-side surface **172** of the seventh lens element **170** is Td, and they satisfy the relation:

$$Dr1r5/Td=0.68.$$

In the first embodiment of the present optical lens system, the distance between the object-side surface **151** of the fifth lens element **150** and the image-side surface **172** of the sev-

enth lens element **170** is Dr9r14, and the distance between the object-side surface **111** of the first lens element **110** and the image-side surface **172** of the seventh lens element **170** is Td, and they satisfy the relation:

$$Dr9r14/Td=0.14.$$

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **110** is f1, the focal length of the second lens element **120** is f2, the focal length of the third lens element **130** is f3, the focal length of the fourth lens element **140** is f4, the focal length of the fifth lens element **150** is f5, the focal length of the sixth lens element **160** is f6, the focal length of the seventh lens element **170** is f7, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

$$SUM|pow|=1.73.$$

In the first embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **110** is f1, the focal length of the second lens element **120** is f2, the focal length of the third lens element **130** is f3, the focal length of the fourth lens element **140** is f4, the focal length of the fifth lens element **150** is f5, the focal length of the sixth lens element **160** is f6, the focal length of the seventh lens element **170** is f7, P5=|f/f5|, P6=|f/f6|, P7=|f/f7|, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

$$(P5+P6+P7)/(SUM|pow|)=0.74.$$

In the first embodiment of the present optical lens system, the distance from the stop **100** to the image plane **190** along the optical axis **191** is SL, the distance from the object-side surface **111** of the first lens element **110** to the image plane **190** along the optical axis **191** is TTL, and they satisfy the relation:

$$SL/TTL=0.20.$$

The detailed optical data of the first embodiment is shown in table 1, and the aspheric surface data is shown in table 2, wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm.

TABLE 1

(Embodiment 1)
f(focal length) = 1.04 mm, Fno = 2.08, HFOV (half of field of view) = 60.4 deg.

Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	23.9554	0.800	Glass	1.804	46.5	−4.54
2		3.1191	3.068				
3	Lens 2	−2.49791 (ASP)	2.355	Plastic	1.633	23.4	25.62
4		−2.95528 (ASP)	2.432				
5	Lens 3	12.9244	1.150	Glass	1.517	64.2	7.86
6		−5.7404	0.100				
7	Lens 4	−2.91828 (ASP)	0.927	Plastic	1.535	56.3	−23.22
8		−4.23760 (ASP)	0.122				
9	Lens 5	3.36830 (ASP)	0.631	Plastic	1.535	56.3	2.33
10		−1.85125 (ASP)	0.100				
11	Stop	Plano	0.100				
12	Lens 6	−4.07630 (ASP)	0.450	Plastic	1.633	23.4	−2.07
13		2.01899 (ASP)	0.102				
14	Lens 7	2.16367 (ASP)	0.450	Plastic	1.535	56.3	3.07
15		−6.27750 (ASP)	0.500				
16	IR-filter	Plano	0.300	Glass	1.517	64.2	
17		Plano	0.500				
18	Cover-glass	Plano	0.400	Glass	1.517	64.2	
19		Plano	0.385				
20	Image	Plano					

Note:
reference wavelength is: d-line 587.6 nm, and the diameter of the effective aperture of the surface # 8 is 1.883 mm.

TABLE 2

Aspheric Coefficients

Surface #	3	4	7	8	9
k =	−4.05761E+00	−3.45086E+00	−2.06355E−01	−1.68071E+01	−2.66733E+01
A4 =	−4.61866E−03	−5.46999E−03	−2.16687E−02	5.59359E−02	2.19869E−01
A6 =	3.80250E−04	3.17206E−04	4.69580E−02	1.00053E−02	−1.79373E−01
A8 =	−4.51368E−05	−1.56938E−05	−1.61291E−02	2.25917E−02	1.15331E−01
A10 =	3.14577E−06	5.19202E−07	1.71009E−03	−1.89280E−02	−1.26740E−01
Surface #	10	12	13	14	15
k =	−4.31394E+00	−4.55257E+01	−8.58818E+00	−1.41156E+01	2.22020E+01
A4 =	1.11579E−01	−9.34202E−02	−1.72997E−01	2.65296E−01	4.05117E−01
A6 =	−2.59933E−01	−5.49754E−02	−1.52281E−02	−2.57219E−01	−2.29317E−02
A8 =	1.93885E−01	7.83217E−01	1.30678E+00	5.44699E−01	−2.70912E−02
A10 =	−8.96668E−02	−8.22802E−01	−1.38068E+00	−4.69459E−01	−1.06369E−01

Referring to FIG. **2**A, which shows an optical lens system with a wide field of view in accordance with a second embodiment of the present invention, and FIG. **2**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the second embodiment of the present invention. The second embodiment of the present invention comprises, in order from the object side to the image side:

A first lens element **210** with negative refractive power made of glass has a convex object-side surface **211** and a concave image-side surface **212**.

A second lens element **220** with negative refractive power made of glass has a convex object-side surface **221** and a concave image-side surface **222**.

A third lens element **230** with positive refractive power made of plastic has a concave object-side surface **231** and a convex image-side surface **232**, and the object-side surface **231** and the image-side surface **232** of the third lens element **230** are aspheric.

A fourth lens element **240** with positive refractive power made of plastic has a concave object-side surface **241** and a convex image-side surface **242**, and the object-side surface **241** and the image-side surface **242** of the fourth lens element **240** are aspheric.

A fifth lens element **250** with positive refractive power made of plastic has a convex object-side surface **251** and a convex image-side surface **252**, and the object-side surface **251** and the image-side surface **252** of the fifth lens element **250** are aspheric.

A sixth lens element **260** with negative refractive power made of plastic has a concave object-side surface **261** and a concave image-side surface **262**, and the object-side surface **261** and the image-side surface **262** of the fourth lens element **260** are aspheric.

A seventh lens element **270** with positive refractive power made of plastic has a convex object-side surface **271** and a convex image-side surface **272**, and the object-side surface **271** and the image-side surface **272** of the seventh lens element **270** are aspheric.

A stop **200** is located between the fourth lens element **240** and the fifth lens element **250**.

An IR cut filter **280** made of glass is located between the image-side surface **272** of the seventh lens element **270** and an image plane **290** and has no influence on the focal length of the optical lens system.

A cover glass **281** made of glass is located between the IR cut filter **280** and the image plane **290** to protect a sensor (not shown), and has no influence on the focal length of the optical lens system.

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and it satisfies the relation:

$$f=0.92.$$

In the second embodiment of the present optical lens system, the f-number of the optical lens system with a wide field of view is Fno, and it satisfies the relation:

$$Fno=2.05.$$

In the second embodiment of the present optical lens system, half of the maximal field of view is HFOV, and it satisfies the relation:

$$HFOV=60.3.$$

In the second embodiment of the present optical lens system, the Abbe number of the seventh lens element **270** is V7, the Abbe number of the sixth lens element **260** is V6, and they satisfy the relation:

$$|V7-V6|=32.50.$$

In the second embodiment of the present optical lens system, the radius of curvature of the object-side surface **221** of the second lens element **220** is R3, the radius of curvature of the image-side surface **222** of the second lens element **220** is R4, and they satisfy the relation:

$$R3/R4=9.48.$$

In the second embodiment of the present optical lens system, the radius of curvature of the object-side surface **241** of the fourth lens element **240** is R7, the radius of curvature of the image-side surface **242** of the fourth lens element **240** is R8, and they satisfy the relation:

$$|(R7+R8)/(R7-R8)|=8.45.$$

In the second embodiment of the present optical lens system, the radius of curvature of the object-side surface **261** of the sixth lens element **260** is R11, the radius of curvature of the image-side surface **262** of the sixth lens element **260** is R12, and they satisfy the relation:

$$(R11+R12)/(R11-R12)=-0.34.$$

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the distance on the optical axis between the fourth lens element **240** and the fifth lens element **250** is T45, and they satisfy the relation:

$$T45/f=2.37.$$

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **210** is f1, and they satisfy the relation:

$$f/f1=-0.15.$$

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the second lens element **220** is f2, and they satisfy the relation:

$$|f/f2|=0.21.$$

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element **240** is f4, and they satisfy the relation:

$$|f/f4|=0.06.$$

In the second embodiment of the present optical lens system, the distance between the object-side surface **211** of the first lens element **210** and the object-side surface **231** of the third lens element **230** is Dr1r5, the distance between the object-side surface **211** of the first lens element **210** and the image-side surface **272** of the seventh lens element **270** is Td, and they satisfy the relation:

$$Dr1r5/Td=0.35.$$

In the second embodiment of the present optical lens system, the distance between the object-side surface **251** of the fifth lens element **250** and the image-side surface **272** of the seventh lens element **270** is Dr9r14, and the distance between the object-side surface **211** of the first lens element **210** and the image-side surface **272** of the seventh lens element **270** is Td, and they satisfy the relation:

$$Dr9r14/Td=0.15.$$

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **210** is f1, the focal length of the second lens element **220** is f2, the focal length of the third lens element **230** is f3, the focal length of the fourth lens element **240** is f4, the focal length of the fifth lens element **250** is f5, the focal length of the sixth lens element **260** is f6, the focal length of the seventh lens element **270** is f7, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

SUM|pow|=1.65.

In the second embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **210** is f1, the focal length of the second lens element **220** is f2, the focal length of the third lens element **230** is f3, the focal length of the fourth lens element **240** is f4, the focal length of the fifth lens element **250** is f5, the focal length of the sixth lens element **260** is f6, the focal length of the seventh lens element **270** is f7, P5=|f/f5|, P6=|f/f6|, P7=|f/f7|, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

(*P*5+*P*6+*P*7)/(SUM|pow|)=0.69.

In the second embodiment of the present optical lens system, the distance from the stop **200** to the image plane **290** along the optical axis **291** is SL, the distance from the object-side surface **211** of the first lens element **210** to the image plane **290** along the optical axis **291** is TTL, and they satisfy the relation:

SL/TTL=0.26.

The detailed optical data of the second embodiment is shown in table 3, and the aspheric surface data is shown in table 4, wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm.

TABLE 3

(Embodiment 2)
f(focal length) = 0.92 mm, Fno = 2.05, HFOV (half of field of view) = 60.3 deg.

Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	7.8242	0.800	Glass	1.804	46.5	−6.23
2		2.9164	2.020				
3	Lens 2	26.4861	0.800	Glass	1.729	54.5	−4.34
4		2.7935	0.900				
5	Lens 3	−6.90340 (ASP)	1.940	Plastic	1.632	23.4	9.52
6		−3.56470 (ASP)	0.419				
7	Lens 4	−4.03370 (ASP)	2.000	Plastic	1.544	55.9	15.12
8		−3.17980 (ASP)	2.079				
9	Stop	Plano	0.100				
10	Lens 5	2.08950 (ASP)	0.771	Plastic	1.544	55.9	1.74
11		−1.50586 (ASP)	0.100				
12	Lens 6	−2.07789 (ASP)	0.450	Plastic	1.632	23.4	−2.14
13		4.19640 (ASP)	0.100				
14	Lens 7	15.24220 (ASP)	0.479	Plastic	1.544	55.9	5.43
15		−3.62830 (ASP)	0.500				
16	IR-filter	Plano	0.300	Glass	1.517	64.2	
17		Plano	0.500				
18	Cover-glass	Plano	0.400	Glass	1.517	64.2	
19		Plano	0.316				
20	Image	Plano					

Note:
reference wavelength is: d-line 587.6 nm.

TABLE 4

Aspheric Coefficients					
Surface #	5	6	7	8	10
k =	−5.00000E+01	−1.00864E+01	7.50423E−01	−5.24959E−01	9.29473E−02
A4 =	1.89598E−02	2.51495E−04	1.69123E−03	1.73493E−03	1.97014E−02
A6 =	−6.76222E−04	3.31961E−03	2.71617E−03	2.89335E−03	−4.06788E−02
A8 =	−2.63523E−05	−1.05598E−03	−3.00081E−04	−8.40675E−04	1.00646E−01
A10 =	3.17227E−05	1.96781E−04	1.06273E−04	1.19946E−04	−2.24553E−01
Surface #	11	12	13	14	15
k =	−1.65332E+00	−1.53641E+01	2.33459E+00	4.93451E+01	−4.34300E+00
A4 =	1.67417E−01	−1.93452E−01	−1.23876E−01	3.12734E−01	3.28044E−01
A6 =	−2.65303E−01	1.11435E−01	1.40265E−01	5.58464E−03	1.37213E−01
A8 =	−3.25895E−02	−2.21060E−01	7.38231E−02	−6.06858E−02	−7.51222E−02
A10 =	4.34582E−02	2.13943E−01	−7.25735E−02	2.42413E−02	1.09873E−02

Referring to FIG. **3**A, which shows an optical lens system with a wide field of view in accordance with a third embodiment of the present invention, and FIG. **3**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the third embodiment of the present invention. The third embodiment of the present invention comprises, in order from the object side to the image side:

A first lens element **310** with negative refractive power made of glass has a convex object-side surface **311** and a concave image-side surface **312**.

A second lens element **320** with positive refractive power made of plastic has a concave object-side surface **321** and a convex image-side surface **322**, and the object-side surface **321** and the image-side surface **322** of the second lens element **320** are aspheric.

A third lens element **330** with positive refractive power made of glass has a convex object-side surface **331** and a convex image-side surface **332**.

A fourth lens element **340** with negative refractive power made of plastic has a concave object-side surface **341** and a convex image-side surface **342**, and the object-side surface **341** and the image-side surface **342** of the fourth lens element **140** are aspheric.

A fifth lens element **350** with positive refractive power made of plastic has a convex object-side surface **351** and a convex image-side surface **352**, and the object-side surface **351** and the image-side surface **352** of the fifth lens element **350** are aspheric.

A sixth lens element **360** with negative refractive power made of plastic has a concave object-side surface **361** and a concave image-side surface **362**, and the object-side surface **361** and the image-side surface **362** of the fourth lens element **360** are aspheric.

A seventh lens element **370** with positive refractive power made of plastic has a convex object-side surface **371** and a convex image-side surface **372**, and the object-side surface **371** and the image-side surface **372** of the seventh lens element **370** are aspheric.

A stop **300** is located between the fifth lens element **350** and the sixth lens element **360**.

An IR cut filter **380** made of glass is located between the image-side surface **372** of the seventh lens element **370** and an image plane **390** and has no influence on the focal length of the optical lens system.

A cover glass **381** made of glass is located between the IR cut filter **380** and the image plane **390** to protect a sensor (not shown), and has no influence on the focal length of the optical lens system.

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and it satisfies the relation:

$$f=1.05.$$

In the third embodiment of the present optical lens system, the f-number of the optical lens system with a wide field of view is Fno, and it satisfies the relation:

$$Fno=2.08.$$

In the third embodiment of the present optical lens system, half of the maximal field of view is HFOV, and it satisfies the relation:

$$HFOV=60.3.$$

In the third embodiment of the present optical lens system, the Abbe number of the seventh lens element **370** is V7, the Abbe number of the sixth lens element **360** is V6, and they satisfy the relation:

$$|V7-V6|=32.50.$$

In the third embodiment of the present optical lens system, the radius of curvature of the object-side surface **321** of the second lens element **320** is R3, the radius of curvature of the image-side surface **322** of the second lens element **320** is R4, and they satisfy the relation:

$$R3/R4=0.85.$$

In the third embodiment of the present optical lens system, the radius of curvature of the object-side surface **341** of the fourth lens element **340** is R7, the radius of curvature of the image-side surface **342** of the fourth lens element **340** is R8, and they satisfy the relation:

$$|(R7+R8)/(R7-R8)|=5.35.$$

In the third embodiment of the present optical lens system, the radius of curvature of the object-side surface **361** of the sixth lens element **360** is R11, the radius of curvature of the image-side surface **362** of the sixth lens element **360** is R12, and they satisfy the relation:

$$(R11+R12)/(R11-R12)=0.29.$$

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the distance on the optical axis between the fourth lens element **340** and the fifth lens element **350** is T45, and they satisfy the relation:

$$T45/f=0.11.$$

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **310** is f1, and they satisfy the relation:

$$f/f1=-0.23.$$

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the second lens element **320** is f2, and they satisfy the relation:

$$|f/f2|=0.04.$$

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element **340** is f4, and they satisfy the relation:

$$|f/f4|=0.05.$$

In the third embodiment of the present optical lens system, the distance between the object-side surface **311** of the first lens element **310** and the object-side surface **331** of the third lens element **330** is Dr1r5, the distance between the object-side surface **311** of the first lens element **310** and the image-side surface **372** of the seventh lens element **370** is Td, and they satisfy the relation:

$$Dr1r5/Td=0.67.$$

In the third embodiment of the present optical lens system, the distance between the object-side surface **351** of the fifth lens element **350** and the image-side surface **372** of the seventh lens element **370** is Dr9r14, and the distance between the object-side surface **311** of the first lens element **310** and the image-side surface **372** of the seventh lens element **370** is Td, and they satisfy the relation:

$$Dr9r14/Td=0.14.$$

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **310** is f1, the focal length of the second lens element **320** is f2, the focal length of the third lens element **330** is f3, the focal length of the fourth lens element **340** is f4, the focal length of the fifth lens element **350** is f5, the focal length of the sixth lens element **360** is f6, the focal length of the seventh lens element **370** is f7, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

SUM|pow|=1.77.

In the third embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **310** is f1, the focal length of the second lens element **320** is f2, the focal length of the third lens element **330** is f3, the focal length of the fourth lens element **340** is f4, the focal length of the fifth lens element **350** is f5, the focal length of the sixth lens element **360** is f6, the focal length of the seventh lens element **370** is f7, P5=|f/f5|, P6=|f/f6|, P7=|f/f7|, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

$(P5+P6+P7)/(\text{SUM}|\text{pow}|)=0.74$.

In the third embodiment of the present optical lens system, the distance from the stop **300** to the image plane **390** along the optical axis **391** is SL, the distance from the object-side surface **311** of the first lens element **310** to the image plane **390** along the optical axis **391** is TTL, and they satisfy the relation:

$SL/TTL=0.20$.

The detailed optical data of the third embodiment is shown in table 5, and the aspheric surface data is shown in table 6, wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm.

TABLE 5

(Embodiment 3)
f(focal length) = 1.05 mm, Fno = 2.08, HFOV (half of field of view) = 60.3 deg.

Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	23.9554	0.800	Glass	1.804	46.5	−4.54
2		3.1191	3.076				
3	Lens 2	−2.50494 (ASP)	2.339	Plastic	1.634	23.8	24.56
4		−2.93955 (ASP)	2.399				
5	Lens 3	12.9244	1.150	Glass	1.517	64.2	7.86
6		−5.7404	0.110				
7	Lens 4	−2.88656 (ASP)	0.962	Plastic	1.535	56.3	−22.93
8		−4.21420 (ASP)	0.119				
9	Lens 5	3.33280 (ASP)	0.636	Plastic	1.535	56.3	2.32
10		−1.84624 (ASP)	0.100				
11	Stop	Plano	0.100				
12	Lens 6	−3.73570 (ASP)	0.448	Plastic	1.634	23.8	−2.03
13		2.06123 (ASP)	0.099				
14	Lens 7	2.07471 (ASP)	0.446	Plastic	1.535	56.3	3.01
15		−6.63370 (ASP)	0.500				
16	IR-filter	Plano	0.300	Glass	1.517	64.2	
17		Plano	0.500				
18	Cover-glass	Plano	0.400	Glass	1.517	64.2	
19		Plano	0.393				
20	Image	Plano					

Note:
reference wavelength is: d-line 587.6 nm, and the diameter of the effective aperture of the surface # 8 is 1.996 mm.

TABLE 6

Aspheric Coefficients					
Surface #	3	4	7	8	9
k =	−4.02505E+00	−3.37773E+00	−2.03484E−01	−1.62042E+01	−2.63862E+01
A4 =	−4.70283E−03	−5.47274E−03	−2.16422E−02	5.58245E−02	2.19908E−01
A6 =	3.79444E−04	3.16412E−04	4.68355E−02	1.00879E−02	−1.78916E−01
A8 =	−4.47309E−05	−1.58171E−05	−1.62055E−02	2.25307E−02	1.15994E−01
A10 =	3.01900E−06	5.02587E−07	1.76786E−03	−1.88785E−02	−1.26046E−01
Surface #	10	12	13	14	15
k =	−4.34375E+00	−4.11699E+01	−8.96095E+00	−1.40644E+01	2.59327E+01
A4 =	1.11391E−01	−9.28528E−02	−1.75368E−01	2.64802E−01	4.01764E−01
A6 =	−2.60448E−01	−5.20602E−02	−1.81425E−02	−2.63285E−01	−2.87011E−02
A8 =	1.94917E−01	7.57643E−01	1.30045E+00	5.39437E−01	−3.71912E−02
A10 =	−8.97405E−02	−7.76902E−01	−1.35367E+00	−4.61152E−01	−9.73450E−02

Referring to FIG. **4**A, which shows an optical lens system with a wide field of view in accordance with a fourth embodiment of the present invention, and FIG. **4**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the fourth embodiment of the present invention. The fourth embodiment of the present invention comprises, in order from the object side to the image side:

A first lens element **410** with negative refractive power made of glass has a convex object-side surface **411** and a concave image-side surface **412**.

A second lens element **420** with positive refractive power made of plastic has a concave object-side surface **421** and a convex image-side surface **422**, and the object-side surface **421** and the image-side surface **422** of the second lens element **420** are aspheric.

A third lens element **430** with positive refractive power made of plastic has a concave object-side surface **431** and a convex image-side surface **432**, and the object-side surface **431** and the image-side surface **432** of the third lens element **430** are aspheric.

A fourth lens element **440** with positive refractive power made of plastic has a concave object-side surface **441** and a convex image-side surface **442**, and the object-side surface **441** and the image-side surface **442** of the fourth lens element **440** are aspheric.

A fifth lens element **450** with positive refractive power made of plastic has a convex object-side surface **451** and a convex image-side surface **452**, and the object-side surface **451** and the image-side surface **452** of the fifth lens element **450** are aspheric.

A sixth lens element **460** with negative refractive power made of plastic has a concave object-side surface **461** and a concave image-side surface **462**, and the object-side surface **461** and the image-side surface **462** of the fourth lens element **460** are aspheric.

A seventh lens element **470** with positive refractive power made of plastic has a convex object-side surface **471** and a convex image-side surface **472**, and the object-side surface **471** and the image-side surface **472** of the seventh lens element **470** are aspheric.

A stop **400** is located between the fifth lens element **450** and the sixth lens element **460**.

An IR cut filter **480** made of glass is located between the image-side surface **472** of the seventh lens element **470** and an image plane **490** and has no influence on the focal length of the optical lens system.

A cover glass **481** made of glass is located between the IR cut filter **480** and the image plane **490** to protect a sensor (not shown), and has no influence on the focal length of the optical lens system.

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and it satisfies the relation:

$$f=1.03.$$

In the fourth embodiment of the present optical lens system, the f-number of the optical lens system with a wide field of view is Fno, and it satisfies the relation:

$$Fno=2.50.$$

In the fourth embodiment of the present optical lens system, half of the maximal field of view is HFOV, and it satisfies the relation:

$$HFOV=60.0.$$

In the fourth embodiment of the present optical lens system, the Abbe number of the seventh lens element **470** is V7, the Abbe number of the sixth lens element **160** is V6, and they satisfy the relation:

$$|V7-V6|=32.50.$$

In the fourth embodiment of the present optical lens system, the radius of curvature of the object-side surface **421** of the second lens element **420** is R3, the radius of curvature of the image-side surface **422** of the second lens element **420** is R4, and they satisfy the relation:

$$R3/R4=0.99.$$

In the fourth embodiment of the present optical lens system, the radius of curvature of the object-side surface **441** of the fourth lens element **440** is R7, the radius of curvature of the image-side surface **442** of the fourth lens element **440** is R8, and they satisfy the relation:

$$|(R7+R8)/(R7-R8)|=6.15.$$

In the fourth embodiment of the present optical lens system, the radius of curvature of the object-side surface **461** of the sixth lens element **460** is R11, the radius of curvature of the image-side surface **462** of the sixth lens element **460** is R12, and they satisfy the relation:

$$(R11+R12)/(R11-R12)=0.01.$$

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the distance on the optical axis between the fourth lens element **440** and the fifth lens element **450** is T45, and they satisfy the relation:

$$T45/f=0.24.$$

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **410** is f1, and they satisfy the relation:

$$f/f1=-0.21.$$

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the second lens element **420** is f2, and they satisfy the relation:

$$|f/f2|=0.08.$$

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element **440** is f4, and they satisfy the relation:

$$|f/f4|=0.12.$$

In the fourth embodiment of the present optical lens system, the distance between the object-side surface **411** of the first lens element **410** and the object-side surface **431** of the third lens element **430** is Dr1r5, the distance between the object-side surface **411** of the first lens element **410** and the image-side surface **472** of the seventh lens element **470** is Td, and they satisfy the relation:

$$Dr1r5/Td=0.56.$$

In the fourth embodiment of the present optical lens system, the distance between the object-side surface **451** of the fifth lens element **450** and the image-side surface **472** of the seventh lens element **470** is Dr9r14, and the distance between the object-side surface **411** of the first lens element **410** and

the image-side surface **472** of the seventh lens element **470** is Td, and they satisfy the relation:

$Dr9r14/Td=0.16$.

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **410** is f1, the focal length of the second lens element **420** is f2, the focal length of the third lens element **430** is f3, the focal length of the fourth lens element **440** is f4, the focal length of the fifth lens element **450** is f5, the focal length of the sixth lens element **460** is f6, the focal length of the seventh lens element **470** is f7, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

SUM|pow|=1.76.

In the fourth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **410** is f1, the focal length of the second lens element **420** is f2, the focal length of the third lens element **430** is f3, the focal length of the fourth lens element **440** is f4, the focal length of the fifth lens element **450** is f5, the focal length of the sixth lens element **460** is f6, the focal length of the seventh lens element **470** is f7, P5=|f/f5|, P6=|f/f6|, P7=|f/f7|, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

$(P5+P6+P7)/(\text{SUM|pow|})=0.75$.

In the fourth embodiment of the present optical lens system, the distance from the stop **400** to the image plane **490** along the optical axis **491** is SL, the distance from the object-side surface **411** of the first lens element **410** to the image plane **490** along the optical axis **491** is TTL, and they satisfy the relation:

$SL/TTL=0.20$.

The detailed optical data of the fourth embodiment is shown in table 7, and the aspheric surface data is shown in table 8, wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm.

TABLE 7

(Embodiment 4)
f(focal length) = 1.03 mm, Fno = 2.50, HFOV (half of field of view) = 60.0 deg.

Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	8.2806	0.600	Glass	1.804	46.5	−4.86
2		2.5701	2.974				
3	Lens 2	−2.99968 (ASP)	2.985	Plastic	1.634	23.8	12.53
4		−3.01850 (ASP)	0.790				
5	Lens 3	−5.81640 (ASP)	2.000	Plastic	1.514	56.8	34.80
6		−4.90040 (ASP)	0.459				
7	Lens 4	−2.62378 (ASP)	1.021	Plastic	1.535	56.3	8.52
8		−1.89034 (ASP)	0.247				
9	Lens 5	3.50480 (ASP)	0.648	Plastic	1.535	56.3	2.62
10		−2.18613 (ASP)	0.100				
11	Stop	Plano	0.141				
12	Lens 6	−2.36134 (ASP)	0.450	Plastic	1.634	23.8	−1.78
13		2.32679 (ASP)	0.141				
14	Lens 7	1.74047 (ASP)	0.644	Plastic	1.535	56.3	3.04
15		−20.91760 (ASP)	0.500				
16	IR-filter	Plano	0.300	Glass	1.517	64.2	
17		Plano	0.500				
18	Cover-glass	Plano	0.400	Glass	1.517	64.2	
19		Plano	0.203				
20	Image	Plano					

Note:
reference wavelength is d-line 587.6 nm.

TABLE 8

Aspheric Coefficients

Surface #	3	4	5	6	7	8
k =	−4.37071E+00	−4.09300E+00	−6.73818E+00	−1.22065E+00	−1.56864E−01	−8.71891E+00
A4 =	5.99077E−05	−3.37026E−03	6.27302E−03	2.68087E−03	−2.26904E−02	4.34455E−02
A6 =	−3.17286E−04	4.53348E−04	1.17562E−03	3.09539E−03	4.67449E−02	1.20813E−02
A8 =	3.05789E−05	−3.16145E−05	5.13661E−05	−5.08434E−04	−1.33691E−02	2.16894E−02
A10 =	6.54054E−08	3.25519E−06	1.96501E−06	3.59641E−04	1.55924E−03	−5.99210E−03
A12 =			−6.02646E−22	−6.02646E−22		

Surface #	9	10	12	13	14	15
k =	−3.08794E+00	−3.69920E+00	−2.47796E+01	5.75325E+00	−8.59103E+00	−2.50993E+01
A4 =	2.52380E−01	1.13614E−01	−3.34741E−02	3.63822E−02	2.98136E−01	2.18110E−01
A6 =	−1.44331E−01	−1.66250E−01	2.95108E−02	−3.39804E−01	−2.56938E−01	1.07945E−01
A8 =	1.42767E−01	2.25415E−01	−3.41542E−01	7.14727E−01	2.95929E−01	−1.64111E−01
A10 =	−3.58446E−02	−1.22418E−01	6.52349E−01	−6.77588E−01	−1.34025E−01	1.38419E−01

Referring to FIG. **5**A, which shows an optical lens system with a wide field of view in accordance with a fifth embodiment of the present invention, and FIG. **5**B shows the longitudinal spherical aberration curves, the astigmatic field curves, and the distortion curve of the fifth embodiment of the present invention. The fifth embodiment of the present invention comprises, in order from the object side to the image side:

A first lens element **510** with negative refractive power made of glass has a convex object-side surface **511** and a concave image-side surface **512**.

A second lens element **520** with negative refractive power made of plastic has a convex object-side surface **521** and a concave image-side surface **522**, and the object-side surface **521** and the image-side surface **522** of the second lens element **520** are aspheric.

A third lens element **530** with positive refractive power made of plastic has a concave object-side surface **531** and a convex image-side surface **532**, and the object-side surface **531** and the image-side surface **532** of the third lens element **530** are aspheric.

A fourth lens element **540** with negative refractive power made of plastic has a concave object-side surface **541** and a convex image-side surface **542**, and the object-side surface **541** and the image-side surface **542** of the fourth lens element **540** are aspheric.

A fifth lens element **550** with positive refractive power made of plastic has a convex object-side surface **551** and a convex image-side surface **552**, and the object-side surface **551** and the image-side surface **552** of the fifth lens element **550** are aspheric.

A sixth lens element **560** with negative refractive power made of plastic has a concave object-side surface **561** and a concave image-side surface **562**, and the object-side surface **561** and the image-side surface **562** of the fourth lens element **560** are aspheric.

A seventh lens element **570** with positive refractive power made of plastic has a convex object-side surface **571** and a convex image-side surface **572**, and the object-side surface **571** and the image-side surface **572** of the seventh lens element **570** are aspheric.

A stop **500** is located between the fourth lens element **540** and the fifth lens element **550**.

An IR cut filter **580** made of glass is located between the image-side surface **572** of the seventh lens element **570** and an image plane **590** and has no influence on the focal length of the optical lens system.

A cover glass **581** made of glass is located between the IR cut filter **580** and the image plane **590** to protect a sensor (not shown), and has no influence on the focal length of the optical lens system.

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, and it satisfies the relation:

$$f=0.89.$$

In the fifth embodiment of the present optical lens system, the f-number of the optical lens system with a wide field of view is Fno, and it satisfies the relation:

$$Fno=2.40.$$

In the fifth embodiment of the present optical lens system, half of the maximal field of view is HFOV, and it satisfies the relation:

$$HFOV=59.9.$$

In the fifth embodiment of the present optical lens system, the Abbe number of the seventh lens element **570** is V7, the Abbe number of the sixth lens element **160** is V6, and they satisfy the relation:

$$|V7-V6|=32.50.$$

In the fifth embodiment of the present optical lens system, the radius of curvature of the object-side surface **521** of the second lens element **520** is R3, the radius of curvature of the image-side surface **522** of the second lens element **520** is R4, and they satisfy the relation:

$$R3/R4=3.93.$$

In the fifth embodiment of the present optical lens system, the radius of curvature of the object-side surface **541** of the fourth lens element **540** is R7, the radius of curvature of the image-side surface **542** of the fourth lens element **540** is R8, and they satisfy the relation:

$$|(R7+R8)/(R7-R8)|=7.41.$$

In the fifth embodiment of the present optical lens system, the radius of curvature of the object-side surface **561** of the sixth lens element **560** is R11, the radius of curvature of the image-side surface **562** of the sixth lens element **560** is R12, and they satisfy the relation:

$$(R11+R12)/(R11-R12)=-0.56.$$

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the distance on the optical axis between the fourth lens element **540** and the fifth lens element **550** is T45, and they satisfy the relation:

$$T45/f=2.94.$$

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **510** is f1, and they satisfy the relation:

$$f/f1=-0.17.$$

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the second lens element **520** is f2, and they satisfy the relation:

$$|f/f2|=0.22.$$

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element **540** is f4, and they satisfy the relation:

$$|f/f4|=0.01.$$

In the fifth embodiment of the present optical lens system, the distance between the object-side surface **511** of the first lens element **510** and the object-side surface **531** of the third lens element **530** is Dr1r5, the distance between the object-side surface **111** of the first lens element **110** and the image-side surface **572** of the seventh lens element **570** is Td, and they satisfy the relation:

$$Dr1r5/Td=0.37.$$

In the fifth embodiment of the present optical lens system, the distance between the object-side surface **551** of the fifth lens element **550** and the image-side surface **572** of the seventh lens element **570** is Dr9r14, and the distance between the object-side surface **111** of the first lens element **510** and the

image-side surface **572** of the seventh lens element **570** is Td, and they satisfy the relation:

$Dr9r14/Td=0.14$.

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **510** is f1, the focal length of the second lens element **520** is f2, the focal length of the third lens element **530** is f3, the focal length of the fourth lens element **540** is f4, the focal length of the fifth lens element **550** is f5, the focal length of the sixth lens element **560** is f6, the focal length of the seventh lens element **570** is f7, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

SUM|pow|=1.89.

In the fifth embodiment of the present optical lens system, the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element **510** is f1, the focal length of the second lens element **520** is f2, the focal length of the third lens element **530** is f3, the focal length of the fourth lens element **540** is f4, the focal length of the fifth lens element **550** is f5, the focal length of the sixth lens element **560** is f6, the focal length of the seventh lens element **570** is f7, P5=|f/f5|, P6=|f/f6|, P7=|f/f7|, SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|, and they satisfy the relation:

$(P5+P6+P7)/(\text{SUM}|\text{pow}|)=0.68$.

In the fifth embodiment of the present optical lens system, the distance from the stop **500** to the image plane **590** along the optical axis **591** is SL, the distance from the object-side surface **511** of the first lens element **510** to the image plane **590** along the optical axis **591** is TTL, and they satisfy the relation:

$SL/TTL=0.25$.

The detailed optical data of the fifth embodiment is shown in table 9, and the aspheric surface data is shown in table 10, wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm.

TABLE 9

(Embodiment 5)
f(focal length) = 0.89 mm, Fno = 2.40, HFOV (half of field of view) = 59.9 deg.

Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	12.38	0.600	Glass	1.804	46.5	−5.32
2		3.1111	1.206				
3	Lens 2	7.09060 (ASP)	1.185	Plastic	1.650	21.4	−4.09
4		1.80548 (ASP)	1.779				
5	Lens 3	−21.83890 (ASP)	2.000	Plastic	1.632	23.4	4.39
6		−2.54743 (ASP)	0.200				
7	Lens 4	−2.53957 (ASP)	1.564	Plastic	1.544	55.9	−64.42
8		−3.33210 (ASP)	2.521				
9	Stop	Plano	0.100				
10	Lens 5	2.13239 (ASP)	0.710	Plastic	1.544	55.9	1.61
11		−1.31589 (ASP)	0.100				
12	Lens 6	−1.43108 (ASP)	0.400	Plastic	1.632	23.4	−1.73
13		5.09880 (ASP)	0.140				
14	Lens 7	5.16900 (ASP)	0.495	Plastic	1.544	55.9	4.00
15		−3.63800 (ASP)	0.500				
16	IR-filter	Plano	0.300	Glass	1.517	64.2	
17		Plano	0.500				
18	Cover-glass	Plano	0.400	Glass	1.517	64.2	
19		Plano	0.303				
20	Image	Plano					

Note:
reference wavelength is: d-line 587.6 nm.

TABLE 10

Aspheric Coefficients

Surface #	3	4	5	6	7	8
k =	1.84790E+00	−4.72228E−01	3.63256E+01	−4.06719E+00	3.14946E−02	3.57157E−02
A4 =	1.36527E−02	1.54865E−02	1.01988E−02	−9.42704E−03	9.91560E−03	−1.53775E−03
A6 =	−2.36178E−03	−1.26499E−03	−7.32888E−05	3.06422E−03	3.50636E−03	2.67240E−03
A8 =	1.42795E−04	−2.19906E−03	−8.83046E−04	−9.70423E−04	−3.90101E−04	−5.64163E−04
A10 =	1.14455E−06	4.02116E−04	1.01882E−04	1.53891E−04	1.04051E−04	4.53251E−05
A12 =	-2.38591E−22	−2.38608E−22				

Surface #	10	11	12	13	14	15
k =	−2.25149E+00	−5.93244E−01	−8.92417E+00	1.14290E+01	−5.00000E+01	−1.16549E+01
A4 =	−9.21522E−03	1.23860E−01	−2.55268E−01	−6.26611E−02	3.26812E−01	3.29132E−01
A6 =	−1.77711E−01	−4.93134E−01	3.13135E−01	2.33412E−01	8.69100E−03	1.30054E−01
A8 =	2.64277E−01	2.54477E−01	−4.02039E−01	−2.22027E−02	−1.08273E−01	−1.13089E−01
A10 =	−9.95569E−01	−2.37170E−01	2.80532E−01	−1.44414E−01	5.16139E−02	3.51237E−02

TABLE 11

	Embodiment 1	Embodiment 2	Embodiment 3	Embodiment 4	Embodiment 5
f	1.04	0.92	1.05	1.03	0.89
Fno	2.08	2.05	2.08	2.50	2.40
HFOV	60.4	60.3	60.3	60.0	59.9
V7 − V6	32.90	32.50	32.50	32.50	32.50
R3/R4	0.85	9.48	0.85	0.99	3.93
|(R7 + R8)/(R7 − R8)|	5.42	8.45	5.35	6.15	7.41
(R11 + R12)/(R11 − R12)	0.34	−0.34	0.29	0.01	−0.56
T45/f	0.12	2.37	0.11	0.24	2.94
f/f1	−0.23	−0.15	−0.23	−0.21	−0.17
|f/f2|	0.04	0.21	0.04	0.08	0.22
|f/f4|	0.04	0.06	0.05	0.12	0.01
Dr1r5/Td	0.68	0.35	0.67	0.56	0.37
Dr9r14/Td	0.14	0.15	0.14	0.16	0.14
SUM|pow|	1.73	1.65	1.77	1.76	1.89
(P5 + P6 + P7)/(SUM|pow|)	0.74	0.69	0.74	0.75	0.68
SL/TTL	0.20	0.26	0.20	0.20	0.25

It is to be noted that the tables 1-10 show different data from the different embodiments, however, the data of the different embodiments is obtained from experiments. Therefore, any product of the same structure is deemed to be within the scope of the present invention even if it uses different data. Table 11 lists the relevant data for the various embodiments of the present invention.

While we have shown and described various embodiments in accordance with the present invention, it should be clear to those skilled in the art that further embodiments may be made without departing from the scope of the present invention.

What is claimed is:

1. An optical lens system with a wide field of view comprising, in order from an object side to an image side:

a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface;

a second lens element;

a third lens element;

a fourth lens element having a concave object-side surface and a convex image-side surface;

a fifth lens element with positive refractive power;

a sixth lens element with negative refractive power;

a seventh lens element, at least one of an object-side and an image-side surfaces of the seventh lens element being aspheric;

wherein there are seven lens elements with refractive power and a stop in the optical lens system; wherein a radius of curvature of an object-side surface of the sixth lens element is R11, a radius of curvature of an image-side surface of the sixth lens element is R12, a focal length of the optical lens system with a wide field of view is f, a focal length of the first lens element is f1, a focal length of the second lens element is f2, a focal length of the third lens element is f3, a focal length of the fourth lens element is f4, a focal length of the fifth lens element is f5, a focal length of the sixth lens element is f6, a focal length of the seventh lens element is f7, a sum of absolute value of the refractive power is SUM|pow| (SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|), a distance from the stop to an image plane along an optical axis is SL, a distance from the object-side surface of the first lens element to the image plane along the optical axis is TTL, and they satisfy the relations:

$$-0.7<(R11+R12)/(R11-R12)<0.7;$$

$$\text{SUM|pow|}<2.5;$$

$$0.15<SL/TTL<0.40.$$

2. The optical lens system with a wide field of view as claimed in claim **1**, wherein an object-side surface and an image-side surface of the sixth lens element are aspheric, the seventh lens element is made of plastic, and the object-side surface and the image-side surface of the seventh lens element are aspheric.

3. The optical lens system with a wide field of view as claimed in claim **2**, wherein the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element is f1, the focal length of the second lens element is f2, the focal length of the third lens element is f3, the focal length of the fourth lens element is f4, the focal length of the fifth lens element is f5, the focal length of the sixth lens element is f6, the focal length of the seventh lens element is f7, an absolute value of the refractive power of the fifth lens element is P5 (P5=|f/f5|), an absolute value of the refractive power of the sixth lens element is P6 (P6=|f/f6|), an absolute value of the refractive power of the seventh lens element is P7 (P7=|f/f7|), the sum of absolute value of the refractive power is SUM|pow|(SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|), and they satisfy the relation:

$$0.5<(P5+P6+P7)/(\text{SUM|pow|})<1.0.$$

4. The optical lens system with a wide field of view as claimed in claim **3**, wherein an object-side surface and an image-side surface of the fifth lens element are convex, the object-side surface and the image-side surface of the sixth lens element are concave, and at least one inflection point is formed on the seventh lens element.

5. The optical lens system with a wide field of view as claimed in claim **4**, wherein the first lens element is made of glass, a refractive index of the first lens element is N1, and it satisfies the relation:

$$N1>1.70.$$

6. The optical lens system with a wide field of view as claimed in claim **5**, wherein the second lens element has a convex object-side surface and a concave image-side surface while having negative refractive power.

7. The optical lens system with a wide field of view as claimed in claim 6, wherein the third lens element has a concave object-side surface and a convex image-side surface while having positive refractive power, the focal length of the optical lens system with a wide field of view is f, a distance on the optical axis between the fourth lens element and the fifth lens element is T45, and they satisfy the relation:

$$2.0<T45/f<3.5.$$

8. The optical lens system with a wide field of view as claimed in claim 5, wherein the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element is f4, and they satisfy the relation:

$$|f/f4|<0.2.$$

9. The optical lens system with a wide field of view as claimed in claim 8, wherein the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element is f1, the focal length of the second lens element is f2, the focal length of the third lens element is f3, the focal length of the fourth lens element is f4, the focal length of the fifth lens element is f5, the focal length of the sixth lens element is f6, the focal length of the seventh lens element is f7, the sum of absolute value of the refractive power is SUM|pow|(SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|), and it satisfies the relation:

$$SUM|pow|<2.0.$$

10. The optical lens system with a wide field of view as claimed in claim 4, wherein a distance between the object-side surface of the fifth lens element and the image-side surface of the seventh lens element is Dr9r14, a distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td, and they satisfy the relation:

$$0.07<Dr9r14/Td<0.25.$$

11. The optical lens system with a wide field of view as claimed in claim 10, wherein the distance between the object-side surface of the fifth lens element and the image-side surface of the seventh lens element is Dr9r14, the distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td, and they satisfy the relation:

$$0.12<Dr9r14/Td<0.18.$$

12. The optical lens system with a wide field of view as claimed in claim 11, wherein an Abbe number of the sixth lens element is V6, an Abbe number of the seventh lens element is V7, and they satisfy the relation:

$$28.0<V7-V6<40.0.$$

13. The optical lens system with a wide field of view as claimed in claim 10, wherein the focal length of the optical lens system with a wide field of view is f, the focal length of the fourth lens element is f4, and they satisfy the relation:

$$|f/f4|<0.1.$$

14. The optical lens system with a wide field of view as claimed in claim 10, wherein a distance between an object-side surface of the first lens element and the object-side surface of the third lens element is Dr1r5, the distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td, and they satisfy the relation:

$$0.5<Dr1r5/Td<0.8.$$

15. The optical lens system with a wide field of view as claimed in claim 10, wherein the focal length of the optical lens system with a wide field of view is f, the focal length of the first lens element is f1, and they satisfy the relation:

$$-0.3<f/f1<-0.1.$$

16. An optical lens system with a wide field of view comprising, in order from an object side to an image side:

a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface;

a second lens element;

a third lens element having a convex image-side surface;

a fourth lens element;

a fifth lens element with positive refractive power having a convex object-side surface and a convex image-side surface;

a sixth lens element with negative refractive power having a concave object-side surface and a concave image-side surface;

a seventh lens element with positive refractive power having a convex object-side surface, at least one inflection point formed on the seventh lens element;

wherein there are seven lens elements with refractive power; wherein a focal length of the optical lens system with a wide field of view is f, a focal length of the fourth lens element is f4, a distance between the object-side surface of the fifth lens element and an image-side surface of the seventh lens element is Dr9r14, a distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td, and they satisfy the relations:

$$|f/f4|<0.2;$$

$$0.07<Dr9r14/Td<0.25.$$

17. The optical lens system with a wide field of view as claimed in claim 16, wherein the fifth lens element, the sixth lens element and the seventh lens element are made of plastic.

18. The optical lens system with a wide field of view as claimed in claim 17, wherein the fourth lens element has a concave object-side surface and a convex image-side surface, a radius of curvature of the object-side surface of the fourth lens element is R7, a radius of curvature of the image-side surface of the fourth lens element is R8, and they satisfy the relation:

$$4.5<|(R7+R8)/(R7-R8)|<9.0.$$

19. The optical lens system with a wide field of view as claimed in claim 18, wherein a distance between the object-side surface of the first lens element and an object-side surface of the third lens element is Dr1r5, a distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td, and they satisfy the relation:

$$0.5<Dr1r5/Td<0.8.$$

20. The optical lens system with a wide field of view as claimed in claim 18, wherein the focal length of the optical lens system with a wide field of view is f, a focal length of the first lens element is f1, and they satisfy the relation:

$$-0.3<f/f1<-0.1.$$

21. The optical lens system with a wide field of view as claimed in claim 18, wherein the first lens element is made of glass, an Abbe number of the sixth lens element is V6, an

Abbe number of the seventh lens element is V7, and they satisfy the relation:

$$28.0<V7-V6<40.0.$$

22. The optical lens system with a wide field of view as claimed in claim **21**, wherein a radius of curvature of the object-side surface of the sixth lens element is R11, a radius of curvature of the image-side surface of the sixth lens element is R12, and they satisfy the relation:

$$-0.7<(R11+R12)/(R11-R12)<0.7.$$

23. The optical lens system with a wide field of view as claimed in claim **18**, wherein the focal length of the optical lens system with a wide field of view is f, a focal length of the first lens element is f1, a focal length of the second lens element is f2, a focal length of the third lens element is f3, the focal length of the fourth lens element is f4, a focal length of the fifth lens element is f5, a focal length of the sixth lens element is f6, a focal length of the seventh lens element is f7, an absolute value of the refractive power of the fifth lens element is P5 (P5=|f/f5|), an absolute value of the refractive power of the sixth lens element is P6 (P6=|f/f6|), an absolute value of the refractive power of the seventh lens element is P7 (P7=|f/f7|), a sum of absolute values of the refractive power is SUM|pow|(SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|), and they satisfy the relation:

$$0.5<(P5+P6+P7)/(\text{SUM}|\text{pow}|)<1.0.$$

24. The optical lens system with a wide field of view as claimed in claim **23**, wherein the absolute value of the refractive power of the fifth lens element is P5 (P5=|f/f5|), the absolute value of the refractive power of the sixth lens element is P6 (P6=|f/f6|), the absolute value of the refractive power of the seventh lens element is P7 (P7=|f/f7|), the sum of absolute values of the refractive power is SUM|pow|(SUM|pow|=|f/f1|+|f/f2|+|f/f3|+|f/f4|+|f/f5|+|f/f6|+|f/f7|), and they satisfy the relation:

$$0.65<(P5+P6+P7)/(\text{SUM}|\text{pow}|)<0.80.$$

25. The optical lens system with a wide field of view as claimed in claim **18**, wherein the distance between the object-side surface of the fifth lens element and the image-side surface of the seventh lens element is Dr9r14, the distance between the object-side surface of the first lens element and the image-side surface of the seventh lens element is Td, and they satisfy the relation:

$$0.12<Dr9r14/Td<0.18.$$

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